VLF – VERY LOW FREQUENCY FIELDS NEAR VDTS AND AN EXAMPLE OF THEIR REMOVAL

Canadian Centre for Occupational Health and Safety

Centre canadien d'hygiène et de sécurité au travail

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AND AN EXAMPLE OF THEIR REMOVAL

BY

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VLF FIELD

It is known that a very low frequency (VLF) pulsed electrical field can be found near some types of video display terminals (Ref. 1). This field is emitted by the so called "fly back" transformer in the video display terminal (see Fig. 1) which is located on the left or right side of the VDT.

The fly-back transformer is a part of the horizontal deflection and high voltage system which sweeps the electron beam across the face of the cathode ray tube.

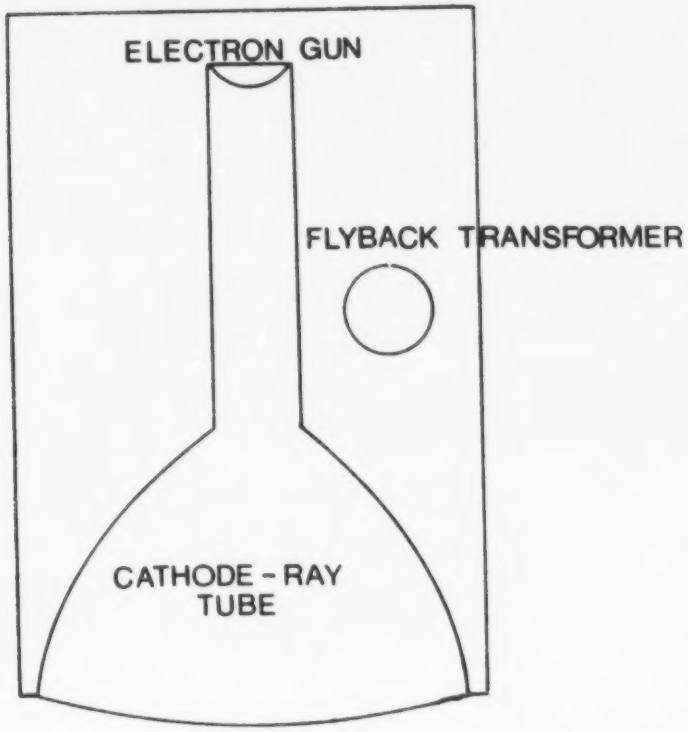

Fig. 1

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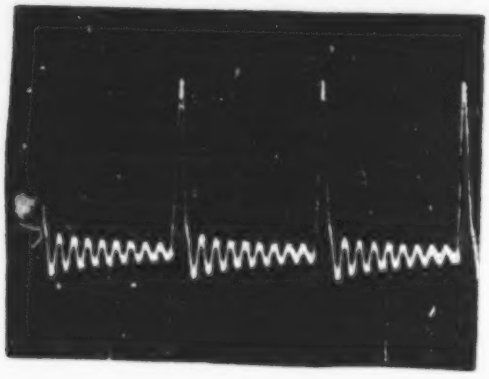
A high voltage (up to 25 kV) is necessary to accelerate the electrons from the electron gun. In order to achieve the correct beam deflection and high voltage, the horizontal output must be pulsed at a frequency corresponding to the product of the number of lines and the refresh rate, usually of the order of 15,900 Hz. This pulsating high voltage creates the pulsed VLF field (see Fig. 2).



WAVEFORM OF 15.9 kHz PULSED FIELD

Fig. 2

WAVEFORM OF 15.9 kHz PULSED FIELD
FROM THE VDT

In some cases (and at some locations) these fields are high enough to raise concern about the possibility of some biological effects. Unfortunately no one has conducted experiments on the biological effects of VLF pulsed electrical fields. However, some papers exist showing that fields with lower repetition frequencies (in the extremely low frequency-ELF-band)* can damage blood cells and even produce some genetic effects (Ref.2). Therefore, the possibility (even if low) of some adverse health effects related to the pulsed VLF fields emitted by some VDT's cannot be ruled out.

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* VLF covers emissions in frequency band 3 to 30 kHz
ELF covers emissions in frequency band 0 to 3 kHz

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While levels of VLF radiation are usually insignificant in front of the VDT screen, relatively high levels can occur towards the side or rear of some terminals. This depends on the design of the unit. As mentioned above, the source of this radiation is the fly-back transformer located on the left or right side of the VDT (depending on the type of VDT). If there are no metallic parts between the fly-back transformer and the surface of the VDT unit then the field will extend outside the unit and workers could be exposed to emissions from nearby terminals.

We at CCOHS used a broadbanding instrument (Model EFS-1) to measure the VLF electric fields surrounding our VDTs. It was found that this instrument can measure the pulsed VLF electric field from VDTs (see Fig. 2) with satisfactory precision (i.e. with error of less than 20%) (Ref 4). In Fig. 3 are summarized the maximum values of the electric field near a terminal with a printer in the unit. In this particular case, the printing mechanism is located on top of the unit and is effective as a shield.

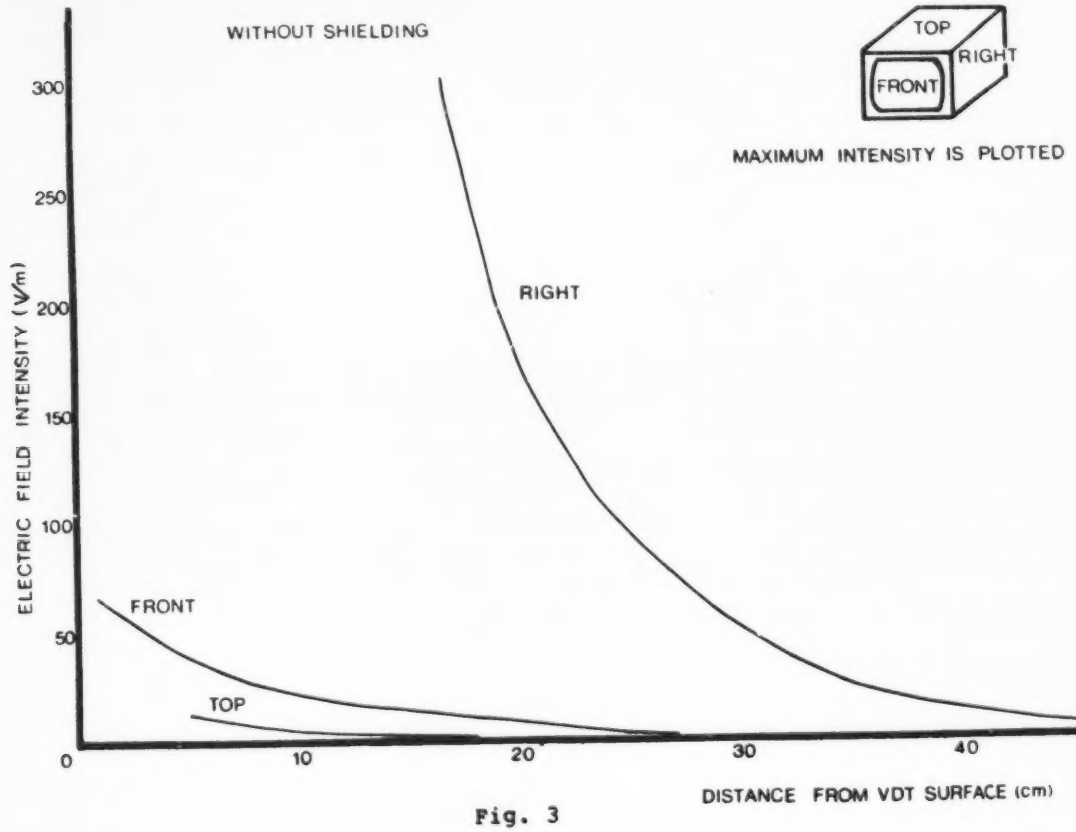

Fig. 3

VLF ELECTRIC FIELD INTENSITY VERSUS DISTANCE FROM TERMINAL WITH PRINTER LOCATED ON TOP OF THE UNIT

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In Fig. 4 are the results of measurements near another terminal without a printer. Note the difference in the field strength at the top as compared with Fig. 3.

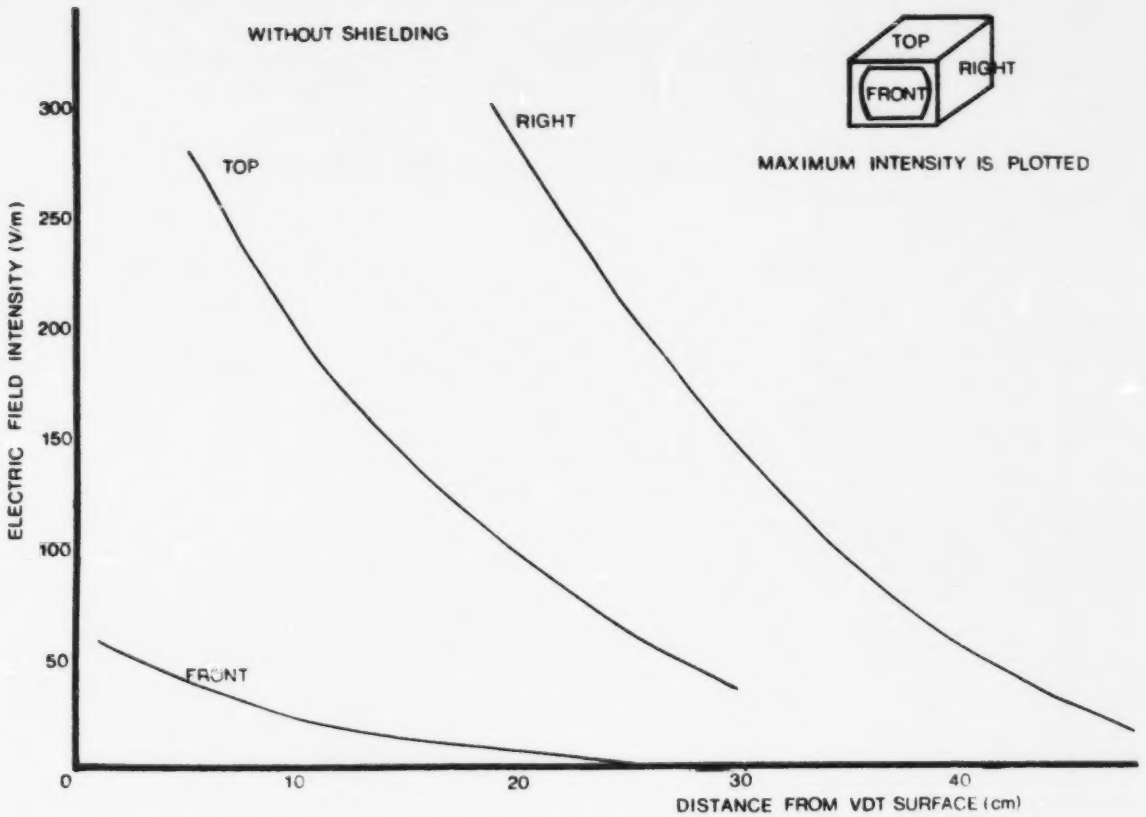

Fig. 4

VLF ELECTRIC FIELD INTENSITY VERSUS DISTANCE FROM TERMINAL WITHOUT PRINTER

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SHIELDING

Because the possible bioeffects of VLF fields on humans are unknown and because there are no exposure limits for such fields, it is reasonable to apply in this case the requirement of the American Conference of Governmental Industrial Hygienists that "All radiofrequency radiation exposures should be kept as low as reasonably possible given the current state of knowledge on human effects, particularly non-thermal effects" (Ref. 3).

Therefore, one of the objectives of our in-house VDT study was to determine if a simple, practical method exists to remove or isolate fields from the area surrounding the unit, in the cases where the field strength was found to be significantly above background. We have been successful in developing and testing a practical method of removing the VLF electric field emissions. Fig. 5 illustrates this method of shielding; the walls of the shielding (made of plywood) are lined with copper foil* and a grounding wire is soldered to it. This grounding wire can be placed around a metal screw on the modem cable (Fig. 6) since the modem cable is shielded and this shielding is connected to the video display terminal main ground.

For the video display terminal without a printer, copper screening** was used to shield the top of the unit. The screen was used instead of foil in order to allow proper air flow (since the ventilation was located on top of the unit). Shielding is not practical on the top of the unit with built-in printer, but fortunately, it is not necessary because the printer acts as a shield.

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* The copper foil can be obtained from Paisley Products of Canada, Inc., 40 Upton Road, Scarborough, Ontario, M1L 2B8. It should be noted that any conducting metal, (aluminum foil for example) would serve as a shield.

** The copper screen can be obtained from Greening Donald Co., Ltd., P.O. Box 430, Hamilton, Ontario, L8N 3J3.

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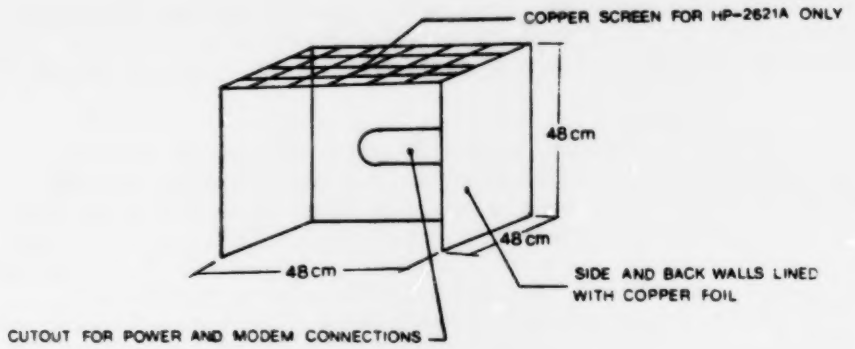
PROPOSED COPPER SHIELDING FOR HEWLETT-PACKARD VIDEO DISPLAY TERMINALS


COPPER SCREEN FOR HP-2621A ONLY
48 cm
48 cm
48 cm
SIDE AND BACK WALLS LINED WITH COPPER FOIL
CUTOUT FOR POWER AND MODEM CONNECTIONS

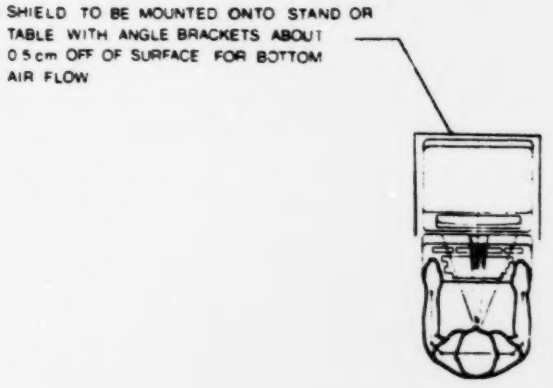

SHIELD TO BE MOUNTED ONTO STAND OR TABLE WITH ANGLE BRACKETS ABOUT 0.5 cm OFF OF SURFACE FOR BOTTOM AIR FLOW
COPPER SCREEN AND FOIL GROUNDED TO INCOMING METAL CONNECTORS

Fig. 5

PROPOSED COPPER SHIELDING FOR VIDEO DISPLAY TERMINALS

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CONNECTION OF GROUNDING WIRE FROM COPPER SCREEN AND FOIL TO METAL SCREW ON INCOMING MODEM CABLE

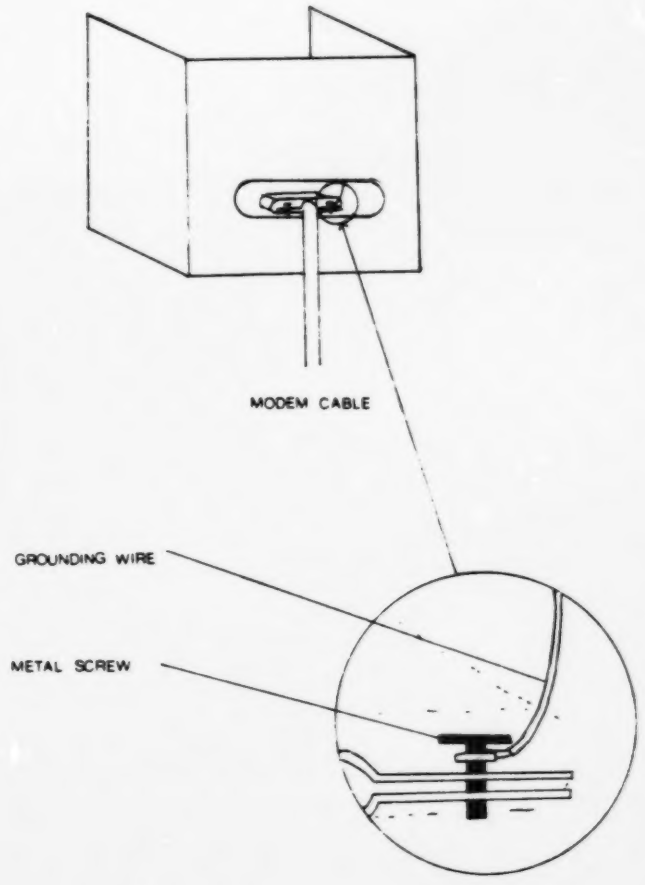

Fig. 6

CONNECTION OF GROUNDING WIRE FROM COPPER SCREEN AND FOIL TO METAL SCREW ON INCOMING MODEM CABLE

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The effect of this shielding on the VLF field around the VDTs is plotted in Fig. 7 and Fig. 8. From these figures it can be seen that, with the use of shielding, the VLF emissions on the right side are reduced to zero whereas the emissions from the front of the screen are unaffected.

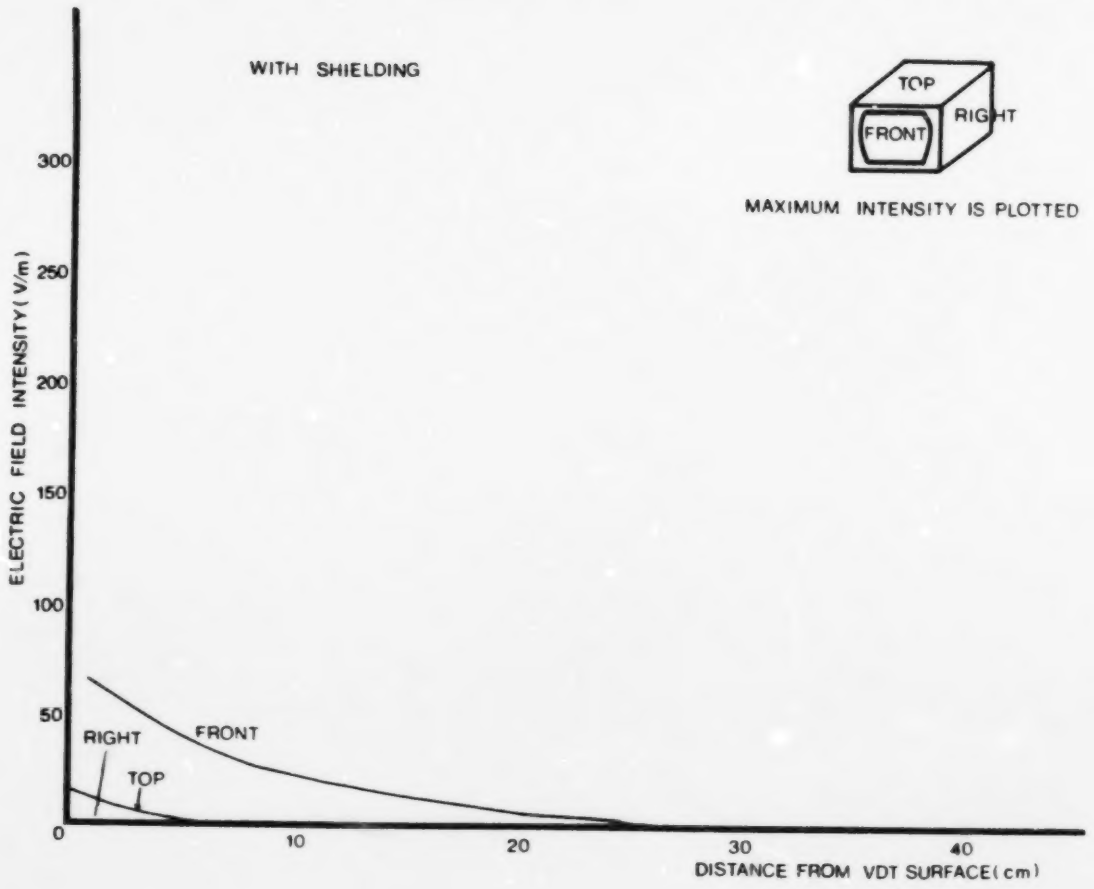

Fig. 7

EFFECT OF SHIELDING ON VLF ELECTRIC FIELD INTENSITY VERSUS DISTANCE FROM TERMINAL WITH PRINTER LOCATED ON TOP OF THE UNIT (COMPARE WITH FIG. 3)

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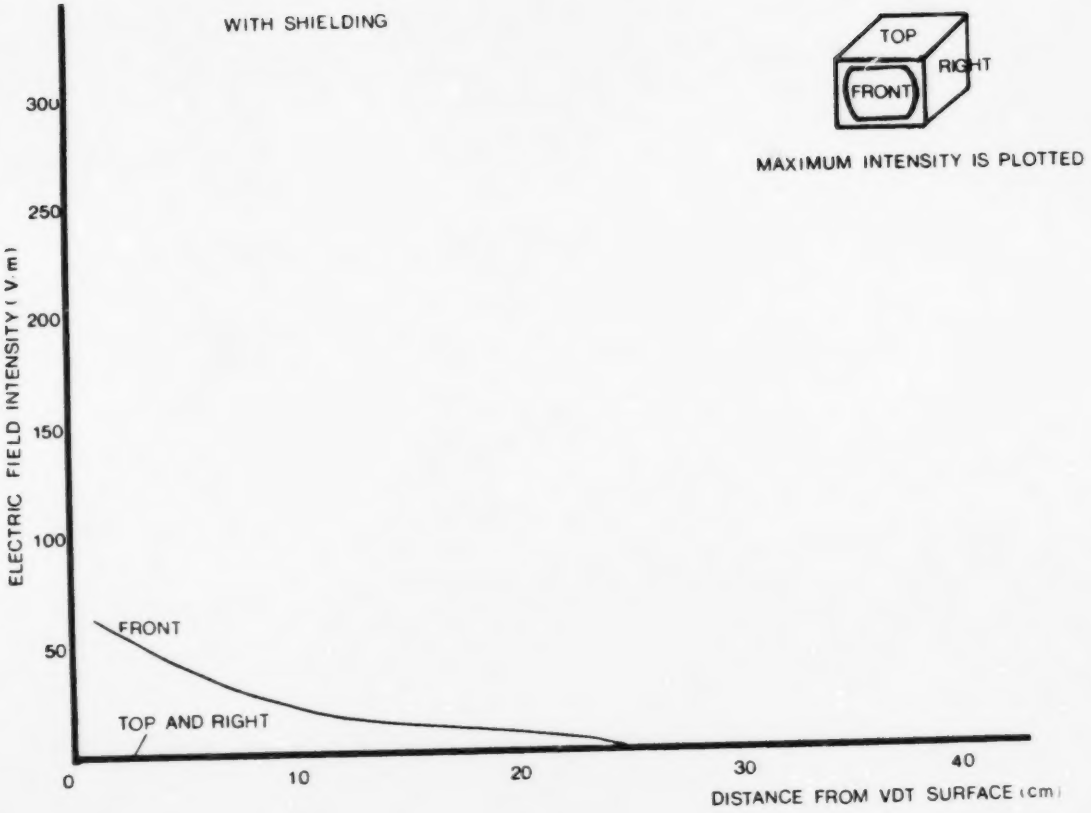

Fig. 8

EFFECT OF SHIELDING ON VLF ELECTRIC FIELD INTENSITY
VERSUS DISTANCE FROM TERMINAL WITHOUT PRINTER
(COMPARE WITH FIG. 4)

It should be noted that even without the ground wire connection, the VLF field is reduced to less than 10V/m (on the right side) but, due to the reflections from the copper foil, 10V/m field appear on the left side of the unit as well.

Various materials were evaluated as shielding medium (see footnote p. 5) and since there has been much interest in the use of lead aprons for VDT operators, they were included in the testing.

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It was found that the lead apron had no measureable effect on the VLF electric field emissions from the Hewlett-Packard units. The use of the lead apron did not result in the absorption or reflection of the VLF emissions. Lead aprons, as used in medical offices, are meant to protect only against penetrating x-radiation, lead being a very good X-ray shielding substance. The lead apron provided no protection against VLF electric field emissions because the lead is there as a compound rather than in metallic form.

ORGANIZATIONAL APPROACH

There is, of course, another way to protect the workers against needless exposure to VLF fields. It is known that the field strength is very rapidly decreased with the distance as can be seen on Fig. 3 and Fig. 4. One can therefore design the workplace in such a way that no one can sit or stand close to the side or behind the VDT unit. A distance of 1 to 1-1/2 meters should be sufficient. VDT's should not be located back to front in a workplace (for example a line of units), since individual operators could be exposed to emissions from nearby terminals. Also, if pregnant workers are relieved of VDT work, they should not sit close to the side or rear of a terminal.

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1) Marha, K. The state of knowledge concerning radiation emissions from video display terminals. Presented at "Science Focus", Ottawa, Ont., October 6, 1982.

2) Marha, K.; Spinner, B.; Purdham, J. The case for concern about very low frequency fields from visual display terminals : the need for further research and shielding of VDT's. CCOHS, April 22, 1983.

3) TLVs threshold limit values for chemical substances and physical agents in the workroom environment with intended changes for 1983-84. American Conference of Governmental Industrial Hygienists, 1983, p. 90.

4) Marha, K.; Charron, D. The very low frequency (VLF) emission testing of CCOHS Video display terminals. CCOHS, August 8, 1983.

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